

WHAT IS CLAIMED IS:

1. BaTiO<sub>3</sub> - PbTiO<sub>3</sub> series single crystal single-crystallized by heating BaTiO<sub>3</sub> - PbTiO<sub>3</sub> compact powder member or sintered member having a smaller Pb-containing mol number than Ba-containing mol number, while keeping said powder or member in non-molten condition.

2. BaTiO<sub>3</sub> - PbTiO<sub>3</sub> series single crystal according to Claim 1, wherein the rearrangement density is 10<sup>2</sup> pieces/cm<sup>2</sup> or more and 10<sup>6</sup> pieces/cm<sup>2</sup> or less, and the ratio of pore content is within a range of 1 volume ppm or more and 5 volume % or less.

3. BaTiO<sub>3</sub> - PbTiO<sub>3</sub> series single crystal according to Claim 1, wherein the ratio of PbTiO<sub>3</sub> content is 45 mol % or less.

4. BaTiO<sub>3</sub> - PbTiO<sub>3</sub> series single crystal according to Claim 3, wherein the ratio of PbTiO<sub>3</sub> content is 30 mol % or less.

5. BaTiO<sub>3</sub> - PbTiO<sub>3</sub> series single crystal according to Claim 4, wherein the ratio of PbTiO<sub>3</sub> content is 25 mol % or less.

6. BaTiO<sub>3</sub> - PbTiO<sub>3</sub> series single crystal according

to Claim 1, wherein the volume of said single crystal is 1 mm<sup>3</sup> or more.

7. A piezoelectric type actuator comprising:  
5 a layer formed by BaTiO<sub>3</sub> - PbTiO<sub>3</sub> series single crystal according to Claim 1.

8. A liquid discharge head comprising:  
the piezoelectric type actuator according to Claim  
10 7.

9. BaTiO<sub>3</sub> - PbTiO<sub>3</sub> series single crystal having the rearrangement density of 10<sup>2</sup> pieces/cm<sup>2</sup> or more and 10<sup>6</sup> pieces/cm<sup>2</sup> or less, and the ratio of pore content  
15 being within in a range of 1 volume ppm or more and 5 volume % or less.

10. BaTiO<sub>3</sub> - PbTiO<sub>3</sub> series single crystal according to Claim 9, wherein the ratio of PbTiO<sub>3</sub>  
20 content is 45 mol % or less.

11. A piezoelectric type actuator comprising:  
a layer formed by BaTiO<sub>3</sub> - PbTiO<sub>3</sub> series single crystal according to Claim 9.

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12. A liquid discharge head comprising:  
the piezoelectric type actuator according to Claim

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13. A method for manufacturing  $\text{BaTiO}_3$  -  $\text{PbTiO}_3$  series single crystal comprising the following step of:

single-crystallizing  $\text{BaTiO}_3$  -  $\text{PbTiO}_3$  compact powder member or sintered member having a smaller Pb-containing mol number than Ba-containing mol number by defining the range of the mol ratio of elements contained therein to be  $0.9800 < (\text{Ba} + \text{Pb}) / \text{Ti} < 1.0000$ , and by heating, while keeping said powder or member in non-molten condition.

14. A method for manufacturing  $\text{BaTiO}_3$  -  $\text{PbTiO}_3$  series single crystal according to Claim 13, wherein the range of the mol ratio of elements contained in said compact powder member or sintered member to be  $0.9900 < (\text{Ba} + \text{Pb}) / \text{Ti} < 0.9999$ .

15. A method for manufacturing  $\text{BaTiO}_3$  -  $\text{PbTiO}_3$  series single crystal according to Claim 14, wherein the range of the mol ratio of elements contained in said compact powder member or sintered member to be  $0.9950 \leq (\text{Ba} + \text{Pb}) / \text{Ti} \leq 1.0000$ .

16. A method for manufacturing  $\text{BaTiO}_3$  -  $\text{PbTiO}_3$  series single crystal according to Claim 13, wherein

the ratio of  $\text{PbTiO}_3$  content in said compact powder member or said sintered member is 45 mol % or less.

5            17. A method for manufacturing  $\text{BaTiO}_3$  -  $\text{PbTiO}_3$  series single crystal according to Claim 16, wherein the ratio of  $\text{PbTiO}_3$  content in said compact powder member or said sintered member is 30 mol % or less.

10           18. A method for manufacturing  $\text{BaTiO}_3$  -  $\text{PbTiO}_3$  series single crystal according to Claim 17, wherein the ratio of  $\text{PbTiO}_3$  content in said compact powder member or said sintered member is 25 mol % or less.

15           19. A method for manufacturing  $\text{BaTiO}_3$  -  $\text{PbTiO}_3$  series single crystal according to Claim 13, comprising the following step of:

             single-crystallizing by heating said compact powder member or sintered member within a temperature  
20        range of 1,200°C or more and 1,400°C or less.

             20. A method for manufacturing  $\text{BaTiO}_3$  -  $\text{PbTiO}_3$  series single crystal according to Claim 13, wherein a compound containing lead is inserted into a furnace  
25        during the single crystal growing process to generate steam containing Pb for the growth of  $\text{BaTiO}_3$  -  $\text{PbTiO}_3$  series single crystal.

21. A method for manufacturing  $\text{BaTiO}_3$  -  $\text{PbTiO}_3$  series single crystal according to Claim 13, comprising the following step of:

single-crystallizing by heating, while keeping  
5 said compact powder member or sintered member in the lead atmosphere and in non-molten condition.

22. A method for manufacturing  $\text{BaTiO}_3$  -  $\text{PbTiO}_3$  series single crystal, comprising the following steps  
10 of:

preparing  $\text{BaTiO}_3$  series single crystal or  $\text{BaTiO}_3$  -  $\text{PbTiO}_3$  series single crystal as seed crystal;

coupling  $\text{BaTiO}_3$  -  $\text{PbTiO}_3$  series sintered member  
composed of crystal grain of average granular diameter  
15 of 20  $\mu\text{m}$  or less, having the relative density of 95% or more, with the {100} plane, {110} plane, or {111} plane of said seed crystal; and

single-crystallizing by heating, while keeping  
said coupled substance in non-molten condition.

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23. A method for manufacturing  $\text{BaTiO}_3$  -  $\text{PbTiO}_3$  series single crystal according to Claim 20, wherein the mol ratio of elements contained in said  $\text{BaTiO}_3$  -  $\text{PbTiO}_3$  series sintered member is within a range of  
25  $0.9950 \leq (\text{Ba} + \text{Pb}) / \text{Ti} \leq 0.9999$ .

24. A method for manufacturing  $\text{BaTiO}_3$  -  $\text{PbTiO}_3$

series single crystal according to Claim 22, wherein a compound containing lead is inserted into a furnace during the single crystal growing process to generate steam containing Pb for the growth of  $\text{BaTiO}_3$  -  $\text{PbTiO}_3$  series single crystal.

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